

INTERGENERATION CORRELATION AND NARROW-SENSE HERITABILITY BETWEEN F_2 AND F_3 GENERATIONS FOR YIELD COMPONENTS IN GREEN GRAM

[*VIGNA RADIATA* L. WILCZEK]

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ABSTRACT

The present investigation aimed to determine the interrelationships and narrow sense heritability among traits in five different crosses BL865 \times Chinamung, LM192 \times MDU3465, BL865 \times SML348, LM192 \times SML348, BL865 \times VGG-4 between F_2 to F_3 generations to make effective selections for improving seed yield and its components. Correlation is an important in estimating the relative importance of various characters on seed yield and it becomes essential to study the contribution of each character to the yield. From this study, results showed that the F_2 yield had a significant and positive correlation with the F_3 . This indicates that under this experimental conditions early generation yield testing at the F_2 could have been used as a reliable predictor of the performances of the crosses at the F_3 generation. Correlation studies between yield components among traits indicated that seed yield was positively and significantly associated with pods per plant, pods per cluster, pod yield per plant and threshing percentage along with their high positive direct effect with seed yield, suggesting that these parameters may be considered as prime traits during the course of selection to have the higher potential of yield in case of green gram. High narrow sense heritability estimates were detected for pod yield per plant, pods per plant, threshing percentage, clusters per plant and plant height and emphasizing that the additive genetic variance was the major component of genetic variation in the inheritance of these traits and the effectiveness of selection for improving these traits. Hence pods per plant, pods per cluster, pod yield per plant and threshing percentage should be given more importance while formulating selection indices for seed yield improvement in green gram.

KEYWORDS: Green Gram, Inter-Generation Correlation Coefficient and Narrow Sense Heritability

INTRODUCTION

Green gram (*Vigna radiata* (L.) Wilczek) is a self-pollinated, legume crop belongs to the family *Leguminaceae*, with a chromosome number $2n=22$, is a crop native to India, cultivated since pre-historic period under rainfed situations for dry seeds. Among the wide array of pulse cultivated in India, Green gram is cultivated in an area of 34.4 lakh ha with production of 14 lakh tons and productivity of 638 kg/ha during (Indiastat.com 2013). In Karnataka green gram is cultivated in an area of 5.28 lakh ha with production of 1.08 lakh tones and the average productivity of 205 kg/ha (Indiastat.com 2013) the productivity is very low due to susceptibility to environmental stresses, pests and diseases.

Green gram holds key position; it has established itself has short duration crop having highly valuable many desirable characters like Protein content (22-26%), wider adoptability, excellent crop for rotation in different cropping systems. Green gram may also be sown as an intercrop or as a green manure to maintain soil health because of their ability to fix atmospheric nitrogen symbiotically. Since green gram is regularly grown under low rainfall conditions and low

fertility lands, frequent drought spells is one of major stress which adversely affects the yield and also poor availability of quality seeds or lack of improved varieties and it was got narrow genetic base, the genes for agronomic characteristics responsible for high yield have been eroded from green gram like other marginal crops, which had relatively little value under the competitive and stress conditions of a wild habitat or a primitive agriculture (Tiwari *et al.*, 1993; Khattak *et al.*, 2001a). However, productivity in the country is still low and there is a need for improvement. Yield is considered as a complex inherited character therefore, indirect selection for yield related characters, which are closely associated with yield and high heritability estimates will be more effective. Selection for desirable genotypes should be made based on seed yield and also other yield component characters which influence the yield. Studies on correlation coefficients of different plant characters are useful criteria to identify desirable traits that contribute to improve the dependent variable. Correlation coefficient is one of the important biometrical tools for formulating a selection index as it reveals the strength of relationship among the group of characters. This also helps to decide the dependability of the characters that have little or no importance. The relationship of a character with yield and other component characters could also be useful for the proper choice of parents. In order to improve yield through breeding techniques, a thorough understanding of variability is prerequisite for a plant breeder. Hence, the present investigation was undertaken to study the magnitude of correlation and narrow sense heritability for various growth and yield parameters in F_2 and F_3 generations of green gram.

MATERIALS AND METHODS

The experimental material for the study was undertaken at K-block, University of Agriculture Sciences, Gandhi Krishi Vignana Kendra, Bangalore during *kharif* 2013 and *summer* 2014. The experimental site is located at an altitude of 899 m above mean sea level and 13 00°N latitude and 77 35°E longitude. The soil type of the experimental block was red sandy loam. The materials comprised of five crosses that were best performing with respect to seed yield and yield related traits and were considered for the present study BL865 \times Chinamung, LM192 \times MDU3465, BL865 \times SML348, LM192 \times SML348, BL865 \times VGG-4 respectively. F_2 population from each cross was evaluated along with parents and checks (KKM-3, Chinamung) for seed yield and yield attributing traits during *kharif* 2013. Best performing plants were selected from among the F_2 individuals of all the crosses based on mean yield performance of the traits such as pods per plant, pod yield per plant, seed yield per plant and threshing percentage and were considered for selecting superior genotypes and F_3 generation was raised on plant-to-row progeny basis using augmented design with 10 compact blocks. Each block was comprised of genotypes, parental lines and check varieties. Each progeny was sown in single row of 3m length with a spacing of 30 cm between the rows and plant to plant distance of 10 cm. All recommended agronomic practices and plant protection measures were followed during the crop growth period to ensure better growth and yield. Since F_2 and F_3 populations are highly segregating for the genes at each loci for which they differ, the observations were recorded on all F_2 and F_3 populations on individual plant basis on the following traits *viz.*, days to first flowering, plant height, primary branches per plant, cluster per plant, pods per plant, pods per cluster, pod length, seeds per pod, pod yield per plant, seed yield per plant and threshing percentage. Genetic parameters inter generation correlation coefficient were calculated as described by Weber and Moorthy (1952) for all the characters studied including seed yield and Heritability in narrow sense estimates were made based on the regression of F_3 on F_2 using the following formula (Cahaner and Hillet, 1980) as per the standard procedure.

EXPERIMENTAL RESULTS

Inter Generation Correlation and Narrow Sense Heritability

Intergeneration Correlation Analysis

Correlation was worked out between F_2 and F_3 progeny means for each of the character and the results are presented in **Table 1**.

Intergeneration correlation for pods per plant was positively and significantly correlated in parent offspring relationship in all the five crosses, with maximum being observed in the cross BL865 \times VGG-4 (0.880) followed by BL 865 \times SML348 (0.767), LM192 \times SML348 (0.764), BL 865 \times Chinamung (0.749) and LM192 \times MDU3465 (0.721). Pod yield per plant also exhibited highest positive significant association in the cross BL865 \times VGG-4 (0.897), BL865 \times SML348 (0.830) and BL865 \times Chinamung (0.789) and LM192 \times MDU3465 (0.754). Similarly seed yield per plant also showed highest intergeneration correlation in the crosses BL865 \times VGG-4 (0.884) followed by BL865 \times SML348 and BL865 \times Chinamung (0.758). Intergeneration correlation was high for plant height in the cross BL 865 \times VGG-4 (0.761), followed by LM192 \times SML348 (0.753) and LM192 \times MDU3465 (0.698). In cluster per plant it was high positive and significant correlation in the cross LM192 \times SML348 (0.763), LM192 \times MDU3465 (0.756) and BL865 \times Chinamung (0.743).

Intergeneration correlation of the cross BL 865 \times Chinamung revealed, high degree of significant positive correlation for pod yield per plant (0.78), seed yield per plant (0.75), pods per plant (0.74), clusters per plant (0.74), plant height (0.62), threshing percentage (0.54), seeds per pod (0.47), primary branches per plant (0.36), pod length (0.31), and pods per cluster (0.26) while, days to first flowering (-0.14) showed negative correlation between parent and progeny.

Intergeneration Correlation of the Cross LM 192 \times MDU 3465 exhibited high degree of significant positive correlation for pod yield per plant (0.75), clusters per plant (0.75), pods per plant (0.72), primary branches per plant (0.71), plant height (0.69), seed yield per plant (0.65), pods per cluster (0.59), threshing percentage (0.44), seeds per pod (0.32) and pod length (0.25) between parent and progeny.

Intergeneration Correlation of the Cross BL 865 \times SML 348 exhibited high degree of significant positive correlation for pod yield per plant (0.83), seed yield per plant (0.80), pods per plant (0.76), pods per cluster (0.60), plant height (0.58), threshing percentage (0.57), clusters per plant (0.57), seeds per pod (0.34), pod length (0.28), days to first flowering (0.25) and primary branches per plant (0.22) between parent and progeny.

Intergeneration Correlation of the Cross LM 192 \times SML 348 showed, high degree of significant positive correlation for clusters per plant (0.76), plant height (0.75), pods per plant (0.67), pod yield per plant (0.66), seed yield per plant (0.62), seeds per pod (0.59), pods per cluster (0.58), threshing percentage (0.55), pod length (0.51) and primary branches per plant (0.24) while, days to first flowering (-0.13) showed negative correlation between parent and progeny.

Intergeneration correlation of the cross BL 865 \times VGG 4 exhibited high degree of significant positive correlation for pod yield per plant (0.89), seed yield per plant (0.88), pods per plant (0.88), threshing percentage (0.71), plant height (0.76), clusters per plant (0.68), pods per cluster (0.66), seeds per pod (0.63), pod length (0.60), primary branches per plant (0.53) and days to first flowering (0.15) between parent and progeny.

Narrow Sense Heritability Estimates through Regression Coefficient (%)

The results obtained from the study are presented in **Table 2**.

BL 865 × Chinamung

High narrow sense heritability was noticed for pod yield per plant (57.38), seed yield per plant (54.32), pods per plant (51.68), plant height (44.18), threshing percentage (43.21), clusters per plant (42.72), pod length (20.56). Moderate narrow sense heritability was observed for seeds per pod (18.40), primary branches per plant (15.33) while, low narrow sense heritability for pods per cluster (8.38) and days to first flowering (7.09).

LM 192 × MDU 3465

High narrow sense heritability was noticed for pod yield per plant (59.18), seed yield per plant (56.09), pods per plant (54.29), clusters per plant (50.17), plant height (44.78), threshing percentage (44.38), pods per cluster (40.99) and primary branches per plant (32.25). Moderate narrow sense heritability was observed for pod length (15.55) and low narrow sense heritability for seeds per pod (9.68) and days to first flowering (3.82).

BL 865 × SML 348

The highest narrow sense heritability was recorded by pod yield per plant (62.79), seed yield per plant (60.89), pods per plant (54.25), threshing percentage (52.29), clusters per plant (43.38), pods per cluster (36.37) and plant height (35.07). Moderate narrow sense heritability was observed for pod length (21.84) and seeds per pod (14.93), while, low narrow sense heritability was observed for days to first flowering (9.91) and primary branches per plant (4.67).

LM 192 × SML 348

High narrow sense heritability was noticed for pod yield per plant (64.35), seed yield per plant (60.92), pods per plant (52.88), threshing percentage (50.30), pods per cluster (35.39), clusters per plant (33.74) and plant height (32.64). Moderate narrow sense heritability was observed for seeds per pod (27.34), pod length (24.73) and primary branches per plant (18.07) and low narrow sense heritability for days to first flowering (9.22).

BL 865 × VGG-4

High narrow sense heritability was noticed for pod yield per plant (65.68), seed yield per plant (61.99), pods per plant (60.65), pods per cluster (57.00), plant height (42.08), threshing percentage (40.12) and clusters per plant (30.42). Moderate narrow sense heritability was observed for seeds per pod (27.07), pod length (23.27) and primary branches per plant (21.55) and low narrow sense heritability for days to first flowering (9.33).

DISCUSSIONS

Inter Generation Correlation and Narrow Sense Heritability between F₂ and F₃ Generation in Green Gram

In a self-pollinated crop like green gram rapid increase in seed yield could be achieved through early generation selection. In early generation, usually single plant selection is employed to assess the response to selection. Intergeneration correlation coefficient and narrow sense heritability based on regression estimates were done by parent progeny (F₂-F₃) regression method. Intergeneration correlation coefficients give an idea about the effectiveness of single plant selection and to some extent on nature of gene action. If the correlation coefficient is high, it would mean high heritable portion and probably the additive component.

In the present study, high degree of positive inter generation correlation was observed for plant height, primary branches per plant, clusters per plant, pods per plant, pods per cluster, pod length, seeds per pod, pod yield per plant, seed yield per plant and threshing percentage in all the crosses, indicating that these traits are mostly governed by additive gene action and considering these traits for selection on individual plant basis, in the advanced generations of segregating population may be effective. Intergeneration correlation coefficients between F₂ and F₃ generations for eleven characters of the five crosses green gram revealed high positive and significant correlation for most of the characters observed. Pods per plant, pod yield per plant, plant height, seed yield per plant and clusters per plant showed high degree of positive significant relationship between parent and progeny, in most of the crosses considered for the study. Indicating that the crosses having BL865 as one of the parent showed highest intergeneration correlation between F₂ and F₃ generations. These characters could be emphasized during selection in F₂ and F₃ generations of different crosses. These findings are supported by reports of Kulkarni *et al.*, (1976) and Reddy *et al.*, (1985). Estimates determined by parent-offspring correlations were generally high, and they arise from gene segregants. In other studies where decisions on the effectiveness of early generation selection were based on parent-offspring correlations, significant correlations have been observed for most narrow sense heritable traits including plant height, primary branches per plant, clusters per plant, pods per plant, pods per cluster, pod length, seeds per pod, pod yield per plant, seed yield per plant and threshing percentage (Rahman and Bahl 1986, Thurling and Ratinam 1989).

As compared to intraclass correlation method, the regression method of estimating narrow sense heritability resulted in consistent and high estimates of heritability. All the traits studied have shown high narrow sense heritability value but days to first flowering showed very less heritability value. This may be due to heterozygous condition of F₂ and F₃. Salimath and Patil (1990) working with F₃ and F₄ generations of chickpea concluded that it appears that the use of regression method is more appropriate for open-pollinated populations, where every individual mates with a random sample of individuals to give rise to its progeny.

CONCLUSIONS

The evaluation of parent and progeny provided an opportunity to compute heritability values following parent offspring regression method involving F₂ plant data and F₃ progeny mean. The heritability estimates computed by regression method can be utilized for predicting the response to selection in early and advanced generations. The high narrow sense heritability was observed for plant height, primary branches per plant, clusters per plant, pods per plant, pods per cluster, pod yield per plant, seed yield per plant and threshing percentage in all the five crosses. It indicates that these characters were governed by additive variance. Therefore, selection will be effective for such traits based on phenotypic observations.

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APPENDICES

Table 1: Intergeneration Correlation Coefficients between F₂ and F₃ Generation for 11 Quantitative Characters in Green Gram

Crosses	Days to First Flowering	Plant Height (cm)	Branches/ Plant	Clusters/ Plant	Pods /Plant	Pods/ Cluster	Pod Length (cm)	Seeds/ Pod	Pod yield/pl. (g)	Seed yield/pl. (g)	Threshing (%)
BL865 × Chinamung	-0.145	0.622**	0.3691**	0.743**	0.749**	0.267**	0.314**	0.478**	0.789**	0.758**	0.557**
LM192 × MDU3465	0.069	0.698**	0.714**	0.756**	0.721**	0.591**	0.258**	0.323**	0.754**	0.655**	0.448**
BL865 × SML348	0.255**	0.580**	0.221**	0.571**	0.767**	0.604**	0.286**	0.343**	0.830**	0.803**	0.572**
LM192 × SML348	-0.137	0.753**	0.246**	0.763**	0.764**	0.588**	0.515**	0.595**	0.669**	0.628**	0.557**
BL865 × VGG-4	0.155**	0.761**	0.535**	0.680**	0.880**	0.662**	0.605**	0.639**	0.897**	0.884**	0.716**

* Significant @ P=0.05 ** Significant @ P=0.01

Table 2: Narrow Sense Heritability (%) between F₂ and F₃ Generation for 11 Quantitative Characters in Green Gram

Crosses	Days to first flowering	Plant height (cm)	Branches/ plant	Clusters/ plant	Pods /plant	Pods/ Cluster	Pod length (cm)	Seeds/ pod	Pod yield/pl. (g)	Seed yield/pl. (g)	Threshing (%)
BL865 × Chinamung	7.09	44.18	15.33	42.72	51.68	8.38	20.56	18.40	54.38	57.32	43.21
LM192 × MDU3465	3.82	44.78	32.25	50.17	54.29	40.99	15.55	9.68	59.18	55.09	44.38
BL865 × SML348	9.91	35.07	4.67	43.38	54.25	36.37	21.84	14.93	62.79	60.89	52.29
LM192 × SML348	9.22	32.64	18.07	33.74	52.88	35.39	24.73	27.34	64.35	60.92	50.30
BL865 × VGG-4	9.33	42.08	21.55	30.42	60.65	57.00	23.27	27.07	65.61	61.11	40.12